Title: A High Impedance State for Digital Subscriber Line Transceivers On Copper Twisted Pairs Applicants: Dasari Jagadish Kumar, et al.

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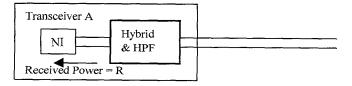


Figure 1: Single Transceiver on a Line

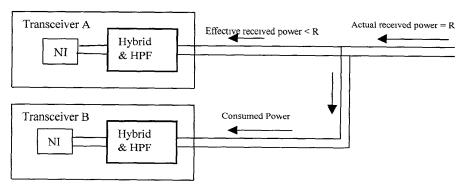


Figure 2: Attenuation of the Received Signal

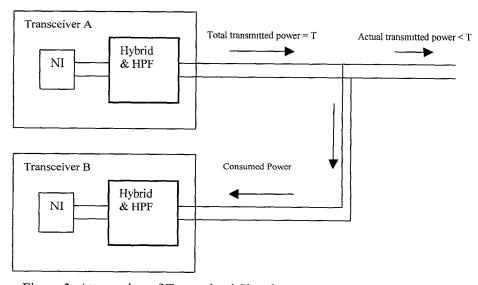


Figure 3: Attenuation of Transmitted Signal

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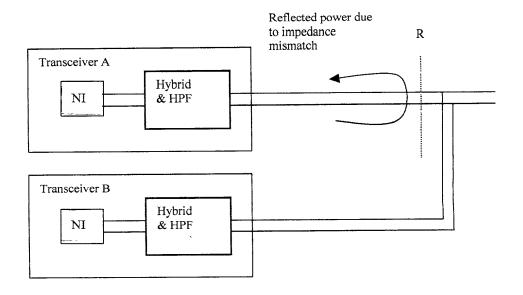


Figure 4: Echo of the Transmitted Signal

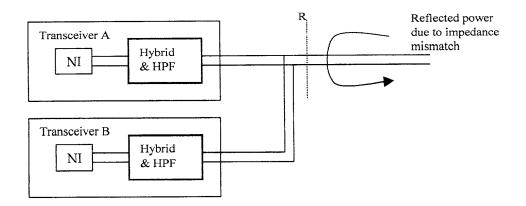


Figure 5: Echo of the Received Signal

## Legend

NI: Normal Impedance

HI: High Impedance

HPF: High Pass Filter

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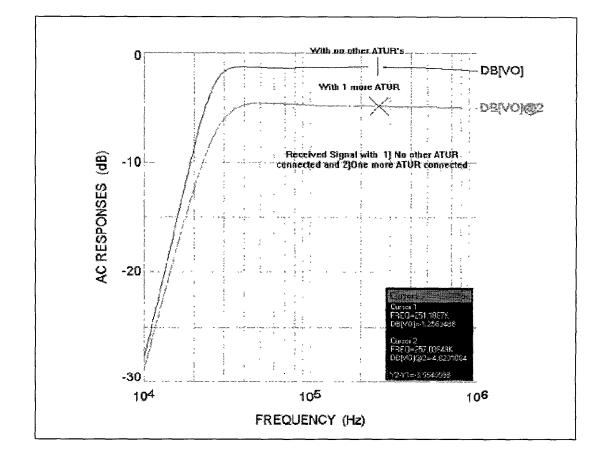


Figure 6: Reduction in the Signal Received by the ATU-R

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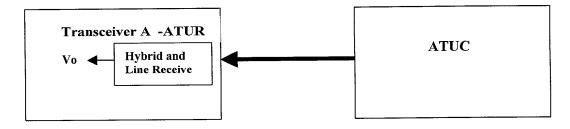


Figure 6a: Signal received when only one ATU-R is connected

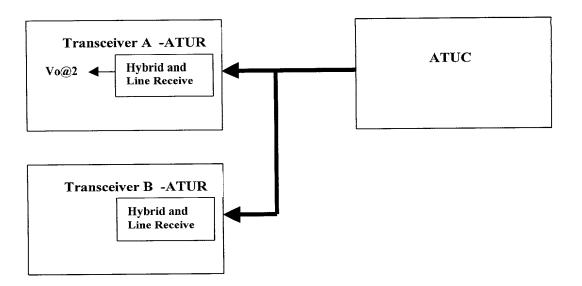


Figure 6b: Signal received when an additional ATU-R is connected to the same line

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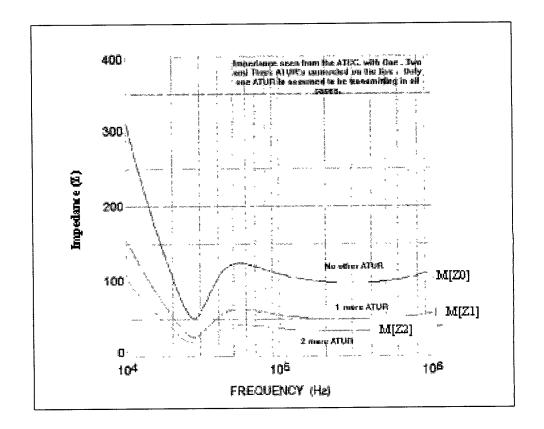


Figure 7: Reduction in the Effective Impedance with Multiple ATU-Rs

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## Impedance Seen from ATUC with only one ATUR Connected, M[Zo] Transceiver A -ATUR Hybrid and Line Receive ATUC

Figure 7a: Impedance seen by the ATU-C with one ATU-R connected to the line

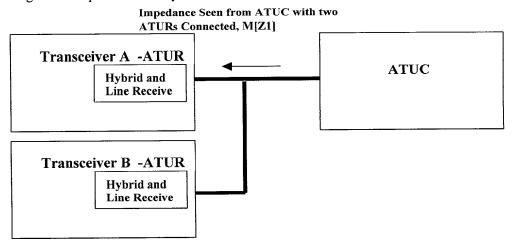


Figure 7b: Impedance seen by the ATU-C with two ATU-Rs connected to the line

## Impedance Seen from ATUC with three ATURs Connected, M[Z2]

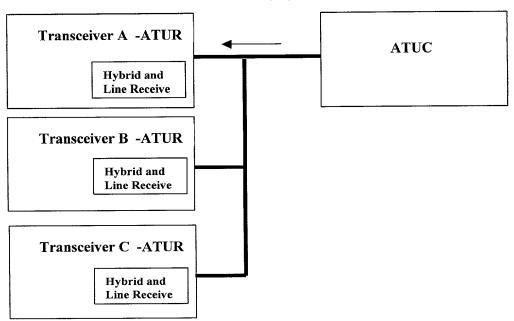


Figure7c: Impedance seen by the ATU-C with three ATU-Rs connected to the line

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Echo Response with Three ATUR's cannected on the Line:

DB[E2]

DB[E1]

Echo Response with Two ATUR's cannected on the Line:

DB[E1]

Echo Response with Two ATUR's cannected on the Line:

DB[E1]

Echo Response with Two ATUR's cannected on the Line:

DB[E1]

Echo Response with Two ATUR's cannected on the Line:

108

109

Echo Response with Two ATUR's cannected on the Line:

109

Echo Response with Two ATUR's cannected on the Line:

100

Echo Response with Two ATUR's cannected on the Line:

101

102

Echo Response with Two ATUR's cannected on the Line:

103

Echo Response with Two ATUR's cannected on the Line:

104

Echo Response with Two ATUR's cannected on the Line:

105

Echo Response with Two ATUR's cannected on the Line:

106

Echo Response with Two ATUR's cannected on the Line:

107

Echo Response with Two ATUR's cannected on the Line:

108

Echo Response with Two ATUR's cannected on the Line:

109

Echo Response with Two ATUR's cannected on the Line:

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Echo Response with Two ATUR's cannected on the Line:

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Echo Response with Two ATUR's cannected on the Line:

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Echo Response with Two ATUR's cannected on the Line:

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Echo Response with Two ATUR's cannected on the Line:

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Echo Response with Two ATUR's cannected on the Line:

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Echo Response with Two ATUR's cannected on the Line:

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Echo Response with Two ATUR's cannected on the Line:

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Echo Response with Two ATUR's cannected on the Line:

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Echo Response with Two ATUR's cannected on the Line:

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Echo Response with Two ATUR's cannected on the Line:

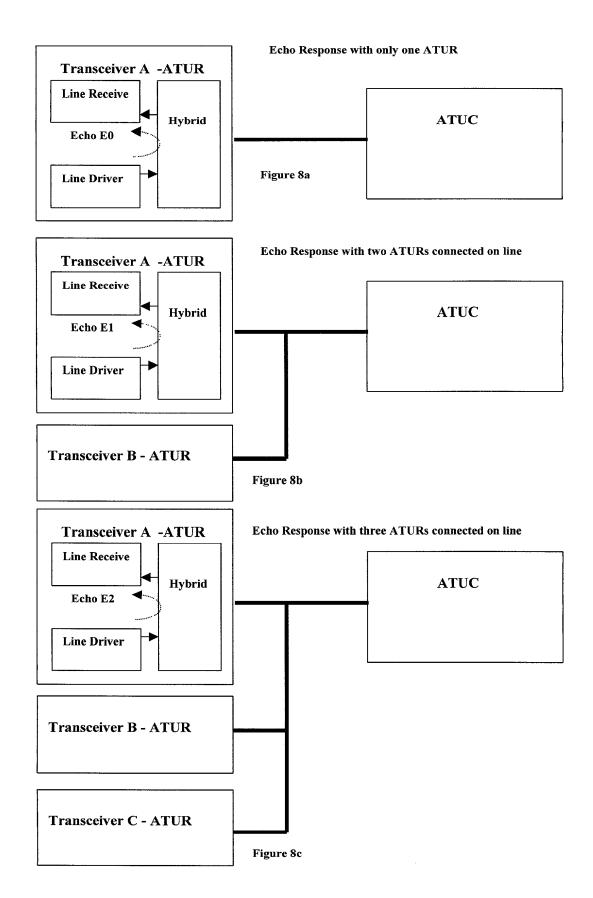
100

Echo Res

Figure 8: Increase in the Echo at the ATU-R due to other ATU-Rs

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A F E Sw1 4 wire Hybrid Line

Figure 9: Implementation 1

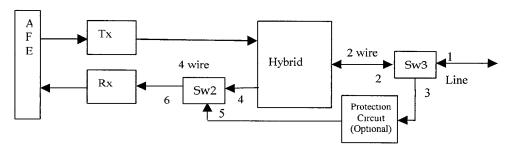


Figure 10: Implementation 2

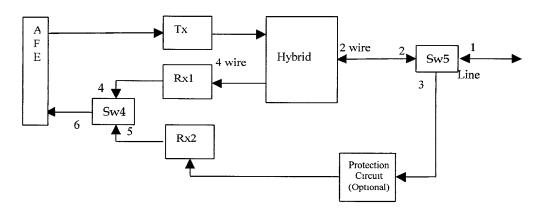


Figure 11: Implementation 3

Legend: Tx: Transmitter, Rx: Receiver, Sw: Switch, AFE: Analog Front End.

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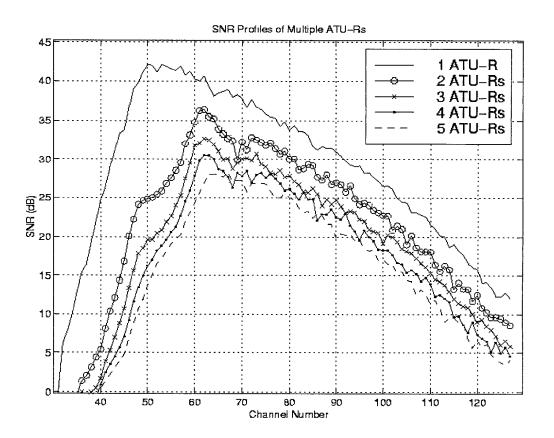


Figure 12: Simulation results of SNR profiles for multiple ATU-Rs

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